COMMUNICATION PATH SELECTION SYSTEM

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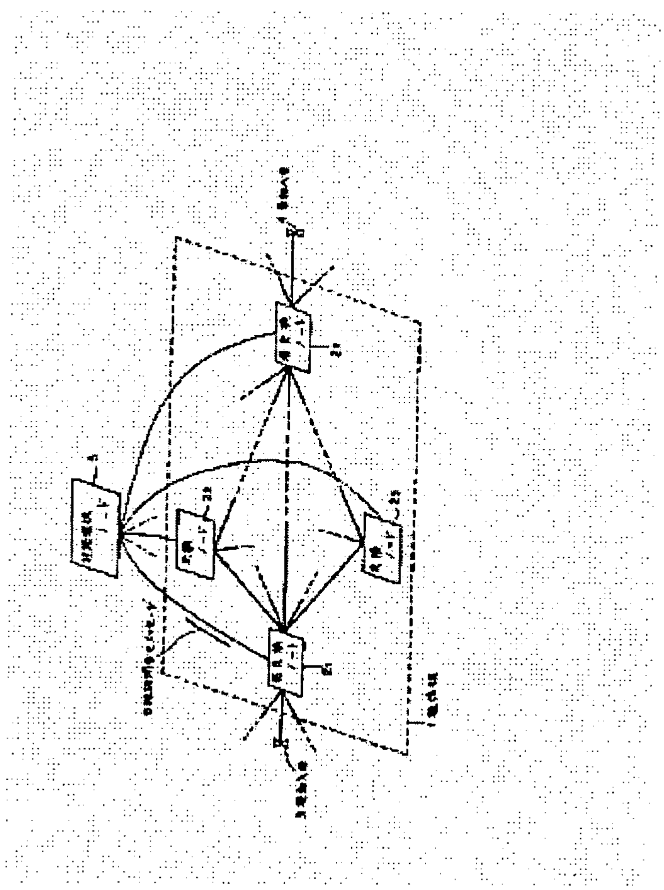
Abstract of **JP2215247**

PURPOSE:To uniformize traffics in a network by applying call setting between an outgoing subscriber and an incoming subscriber in an optimum path connecting an outgoing exchange node selected by a path selection node and an incoming exchange node accommodating an incoming subscriber. CONSTITUTION:Path selection node 5 applying managing integrally path information in a communication network 1 is provided. The node 5 is connected to exchange nodes 21, 22...2n in the communication network 1 via, e.g. a common line signal network, and the path information among the exchange nodes is managed centralizingly while applying transmission reception of a control signal with each node. Then an outgoing exchange node 21 receiving a call signal from an outgoing subscriber 3 sends a path inquiry message 6 including identification information of the node 21, identification information of the incoming subscriber 4 and request information quantity to the node 5. The node 5 decides the optimum path connecting the node 21 and an incoming exchange node 2n accommodating the incoming subscriber 4 in response to the transmission of the message 6 and applies call setting between the subscribers 3 and 4 based on the optimum path. Thus, traffics in the network are uniformized.



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Specification

1. Title of the Invention

COMMUNICATIONS ROUTE SELECTION SYSTEM

2. Patent Claim

1) A communications route selection system in which

in a communications network (1) consisting of a plurality of switching nodes (2_1-2_n),

a route selection node (5) is provided for unified management of route information in said communications network (1),

a calling switching node (2_1) that received a calling signal from a calling subscriber (3) sends to said route selection node (5) a route enquiry message (6) containing the identification information of said calling switching node (2_1), the identification information of a called subscriber (4), and the request information amount, and

call setting between said calling subscriber (3) and said called subscriber (4) is conducted via the optimum route connecting said calling switching node (2_1) and said called switching node (2_n) containing said called subscriber (4) that was selected by said route selection node (5) in response to said route enquiry message (6).

2) The communications route selection system as described in Claim 1, wherein

said route selection node, in accordance with said optimum route selected in response to said route enquiry message, returns the route information consisting of identification information of the called switching node and identification information of each switching node present between said node and said calling switching node to said calling switching node based on identification information of said calling switching node contained in said route enquiry message, and

circuits corresponding to said optimum route to said called switching node are set and call setting between said calling subscriber and said called subscriber is conducted by repeating operations of distinguishing a switching node which is next to be connected based on the received route information, selecting a circuit to said node, and sending a call setting signal containing said route information to said node for each switching node from said calling switching node to said called switching node.

3. Detailed Description of the Invention

(Synopsis)

The present invention relates to a communications route selection system for selecting a route from a calling switching node to a called switching node in a network in an ATM switching system and conducting call setting corresponding to the selected route.

The object is to select an optimum route for information between the users so as to minimize a blocking ratio during communication, to provide for uniform traffic in the network and also to execute an optimum call setting procedure minimizing the overhead (delay) during call setting.

In a communications network consisting of a plurality of switching nodes, a route selection node is provided for unified management of route information in the communications network, a calling switching node that received a calling signal from a calling subscriber sends to the route selection node a route enquiry message containing the identification information of the calling switching node, the identification information of a called subscriber, and the request information amount, and call setting between the calling subscriber and the called subscriber is conducted via the optimum route connecting the calling switching node and the called switching node containing the called subscriber that was selected by the route selection node in response to the route enquiry message.

(Field of Industrial Utilization)

The present invention relates to a communications route selection system for selecting a route from a calling switching node to a called switching node in a network in an ATM switching system and conducting call setting corresponding to the selected route.

(Prior Art Technology)

Next generation ISDN, that is, broad band ISDN complying with the basic implementation period of ISDN (integrated service digital network) and capable of handling a larger volume of information have been actively studied. Among them, the ATM

(asynchronous transfer mode) system is the most promising data transfer system of broad band ISDN.

ATM combines the following advantages of the conventional packet switching system and circuit switching system: data transfer is possible in any communications band (communications speed and communications time) which is the advantage of the packet switching system, and real time data transfer can be conducted between the terminal by high-speed cyclic operations per time slot unit, which is the advantage of the circuit switching system.

More specifically, in ATM the circuits are used in a time slot multiplexing mode and the user conducts transfer by placing a packet of a fixed length (several tens of bytes), which is called a cell, into the vacant time slot on the circuit. Therefore, by increasing and decreasing the number of cells transferred per unit time the user can arbitrarily change the communications speed. A header containing a logic channel number for logic coupling with the destination terminal, an error correcting code, and the like are attached to the cell. In the switchboard, the cells successively input in a time slot unit are high-speed switched in parallel in cell unit (time slot units) by time-division switching of hardware based on the logic channel numbers present in the headers of the cells. Further, the protocol control such as error control – resending control and flow control is implemented at the user terminal and an optical network is used as the transmission route. The combination of such technologies makes it possible to transmit various data within a range from several bits per second to several hundreds of megabits per second in a real time mode with a very high efficiency.

However, in order to employ effectively a significant freedom in selecting the communications band, which is a feature of ATM, it is necessary to resolve a problem of how to establish the correspondence between the resources in the network and the call setting request.

In the conventional circuit switching system based on time division multiplexing (TDM), situations may occur when communication is rejected in response to a call setting request (such a situation is referred to as blocking hereinbelow) because of lack of resources in the network during call setting, for example, because the route for establishing communication between a calling subscriber and a called information in the network is

occupied by another call. However, once the set calling has been completed and the circuit has been set, blocking of the call (communication) during communication cannot occur. By contrast, in ATM the call setting request is similarly rejected in case of insufficient network resources during call setting, but blocking of a call (communication) can also occur during communication. This is because the ATM is a statistical multiplexing communications system having a variable band and the total of bandwidth of the information from a subscriber passing via a set circuit can sometimes exceed the band capacity of a temporarily set circuit because of a burst (a large volume of data is concentrated and transferred). In order to resolve this problem, high-speed switching is required and protocol configuration which is as easy as possible should be employed in the ATM switch. As a result, a cell corresponding to block occurrence is discarded and user's information is lost.

(Problem Addressed by the Invention)

Therefore, when a statistical multiplexing communications system such as ATM system is implemented, it is necessary to employ a route selection (routing, the same hereinbelow) system such that minimizes blocking ratio in the course of communication during routing.

Furthermore, it is necessary to provide an optimum call setting procedure for each routing, that is, a procedure for setting an optimum call between switching nodes (calling switchboard – relay switchboards – called switchboard) on the selected route.

It is an object of the present invention to provide for uniform traffic in a network by selecting an optimum route from information between the users such as to minimize the blocking ratio during communication and also to execute an optimum call setting procedure minimizing the overhead (delay) during call setting.

(Means to Resolve the Problems)

Fig 1 is a block diagram illustrating the present invention. The present invention is based on a communications network 1 composed of a plurality of switching nodes 2_1, 2_2, 2_3,

..., 2_n. The network 1 is, for example, a wide-band ISDN based on ATM (asynchronous transfer mode) system.

The system in accordance with the present invention, first, comprises a route selection node 5 for unified management of route information in said communications network 1. This means is, for example, connected to switching nodes 2_1, 2_2, 2_3, ..., 2_n in communications network 1 via a common channel signal network and provides for concentrated management of route information between the switching nodes, while sending and receiving control signals between those nodes.

In accordance with the present invention, a calling switching node 2_1 that received a calling signal from a calling subscriber 3 sends to the route ~~selection node 5~~ a route enquiry message 6 containing the identification information of the calling switching node 2_1, the identification information of a called subscriber 4, and the request information amount. In response, the route selection node 5 determines an optimum route connecting the calling switching node 2_1 and called switching node 2_n containing the called subscriber 4 and conducts call setting between the calling subscriber 3 and called subscriber 4 based on this optimum route.

For example, the following specific operations can be conducted to execute the above-described control operations. First, the route selection node 5, in accordance with the optimum route selected in response to the route enquiry message 6, returns the route information consisting of identification information of the called switching node 2_n and identification information of each switching node present between this node and the calling switching node 2_1 to the calling switching node 2_1 based on identification information of calling switching node 2_1 contained in the route enquiry message 6. In the calling switching node 2_1, a switching node which is next to be connected is distinguished based on the received route information, a circuit to this node is selected, and a call setting signal containing the route information is sent to this node. Furthermore, in the next switching node that received the call setting signal containing the route information, in the same manner as described above, a switching node which is next to be connected is distinguished based on the received route information, a circuit to this node is selected, and a call setting signal containing the route information is sent to this node. Then, the above-described operations are

repeated in each switching node, thereby setting circuits corresponding to the optimum route to the called switching node 2_n and conducting call setting between the calling subscriber 3 and called subscriber 4.

Furthermore, the route selection node 5, in order to determine the optimum route, comprises route candidate extraction means for extracting at least one route candidate from the calling switching node 2_1 to the called switching node 2_n based on the route enquiry message 6 sent from the calling switching node 2_1 and optimum route selection means for selecting the route candidate with a minimum usage rate from all of the route candidates as the optimum route.

The optimum route selection means is, for example, composed of present usage rate recognition and storage means for recognizing and storing the present usage rate of circuits corresponding to links $2_1 - 2_2$, $2_t - 2_2$ (illegible) between switching nodes in communications network 1, maximum capacity storage means for storing the maximum capacity of circuit, means for calculating the usage rate corresponding to a link which calculates usage rates of circuits corresponding to links between the switching nodes among the above-mentioned route candidates as ratios obtained by adding the above-mentioned request information amount attached to the route enquiry message 6 to the present usage amount for circuits and dividing by the maximum capacity of circuits corresponding to the sum obtained, and means for calculating the usage rate corresponding to a route which calculates the usage rate of the route candidates as a maximum usage rate among the usage rates of circuits corresponding to links between the switching nodes in routes that is determined by the means for calculating the usage rate corresponding to a link.

In case there are several routes with a minimum usage rate, the optimum route selection means determines the optimum route, for example, based on the preset priority.

(Operation)

The route selection node 5 conducts unified management of information relating to the route selection between the switching nodes and selects an optimum route between the calling

switching node 2_1 and called switching node 2_n, and call setting between the calling subscriber 3 and called subscriber 4 is conducted in the communications network 1 based on the optimum route. As a result, the uniformity of traffic in the network can be improved.

Furthermore, in the call setting procedure, first, the route selection node 5 returns the route information to the calling switching node 2_1, and then, while the route information and call setting signal are successively transferred from the calling switching node 2_1 to the called switching node 2_n, in each of the switching nodes the next switching node to which the connection should be made is selected based on the received route information, a circuit to the selected node is selected, and the call setting signal containing the route information is sent to the next node. Therefore, circuits corresponding to the optimum route to the called switching node 2_n are successively set, the overhead (delay) during call setting is minimized, and call setting between the calling subscriber 3 and called information 4 can be conducted.

(Embodiments)

An embodiment of the present invention will be described hereinbelow with reference to the drawings attached.

Fig 2 illustrates the entire configuration of the communication network in the present embodiment. As shown in the figure, the communication network comprises an information transmission network and a common channel signal network 10. Here, a broad band ISDN based on ATM (asynchronous transfer mode) is a specific example of a communication network.

As shown in Fig 2, the information transmission network 7 is composed of a plurality of switching nodes (a), (b), (c), and (d). Those switching nodes are the switches for freely switching and connecting the communication information between a plurality of input circuits and a plurality of output circuits. For convenience, in the below-described explanation, an information transmission network consisting of only four above-mentioned switching nodes will be considered. In reality, the network can be composed of a large number of switching nodes.

In the information transmission network 7, a calling subscriber (calling user) 8

contained, for example, in the switching node (a) and a called subscriber (called user) contained, for example, in the switching node (d) communicate via one of a plurality of communication routes conducting connection via a plurality of relay switching nodes (b), (c) connecting the switching node (a) and the switching node (d).

On the other hand, control information transferred between the switching nodes (a)-(d) is transmitted via a common channel signal network 10 other than the information transmission network 7. The common channel signal network 10 is composed of a plurality of common channel relay nodes 11_1-11_n.

Furthermore, route selection nodes (DB nodes) 12 are connected to the switching nodes (a)-(d) via the above-mentioned common channel signal network 10. Those nodes are responsible for concentrated control of route information between various switching nodes in the information transmission network 7.

Fig 3 shows a configuration of a switching node (a) shown in Fig 2.

The switching node (a) contains a plurality of subscribers 13_1-13_n (one of them is a calling subscriber 8 shown in Fig 2). The calling signals from the subscribers are received by the subscriber line signal devices (SSE) 14_1-14_p provided according to circuits containing the subscribers and then introduced into a central processing unit (CPU) 15.

In CPU 15, the preset switching is conducted based on the calling signals and the connection state of speech switch (SW) 16 is controlled. In this case, the data are processed by conducting reading or writing operation with respect to a preset region on a memory device (MEM) 17.

The output of SW16 is connected to switching nodes (b), (c) and the like shown in Fig 2 , forming circuits a-b, a-c, and the like between the nodes.

Furthermore, common channels from the common channel signal network 10 shown in Fig 2 are connected to CPU 15 via a common channel signal device (CSE).

The configuration of the switching node (d) shown in Fig 2 is similar to that of the switching node (a).

On the other hand, the configuration of switching nodes (b) and (c) is also the same as that of the above-described nodes, except that a portion shown by a broken line 19 in Fig 3 is removed. In the embodiment shown in Fig 2, those nodes are switching nodes used

specifically for relay and contain no subscribers. In this case, the inter-node circuits a-b, a-c from the switching node (a) are input to the input side of SW 16. It is also possible that the switching nodes (b) and (c) contain subscribers similarly to switching nodes (a) and (d).

Fig 4 shows the configuration of the route selection node 12 shown in Fig 2.

The entire operation of the node is controlled by CPU 20. CSE 22, MEM 23, and data base storage (DB) 24 are connected to CPU 20 via a bus 21.

A common channel from the common channel signal network 10 shown in Fig 2 is connected to CSE 22.

DB 24, as described below, is a storage for storing route information between switching nodes (a), (b), (c), and (d) shown in Fig 2. It can be, for example, a disk storage.

The operation of the embodiment shown in Figs 2 to 4 will be described below.

A specific example will be considered with respect to the present embodiment, in which a connection request was generated from the calling subscriber 8 contained in switching node (a) shown in Fig 2 to the called subscriber 9 contained in the switching node (d). In general the operation of the present embodiment can be divided in a route selection processing in a route selection node shown in Figs 2 and 4 and a call setting processing between the switching nodes corresponding to the selected optimum route. In the explanation of the entire processing, first, the call setting processing between the switching nodes and the respective call disconnection processing will be described and then the route selection processing in the route selection node 12 and release processing accompanying the disconnection processing will be described.

Thus, the call setting processing will be described below with reference to an operation diagram shown in Fig 5 and an operation timing chart shown in Fig .6.

Initially, when the calling subscriber 8 does not communicate with the called subscriber 9, the calling subscriber 8, as shown in Fig 5 or Fig 6 (1), attaches the destination number (for example, 045-201-9222) and a requested speed (for example, 6 Mb/s) information to a call signal and sends it to the calling switching node (a) containing the calling subscriber (this node will be referred to as a calling switching node (a) hereinbelow). Here, the requested speed information is the information for asking what is the desired level of transfer speed during the communication.

In the calling switching node (a), the CPU 15 shown in Fig 3 receives the above-described signal via SSE 14 and then, as shown in Fig 5(2), sends a route enquiry message from CSE 18 shown in Fig 3 to the route selection node 12 via the common channel signal network 10 in order to determine the optimum route to the switching node (d) (this node will be referred to as a called switching node (d) hereinbelow) containing the called subscriber 9. In this process, the requested speed information "6 Mb/s", destination number "045-201-9222", and identification number "calling PC = a" of the calling switching node (a) are attached to the message, as shown in Fig 6(2).

In the route selection node 12, the signal is received by CPU 20 via CSE 22 and then an optimum route is selected by the below-described processing from the requested speed information "6 Mb/s", destination number "045-201-9222", and identification number "calling PC = a" of the calling switching node (a) contained in the route enquiry message, and a route enquiry response message is returned from CSE 22 shown in Fig 4 to the calling switching node (a) via the common channel signal network 10, as shown in Fig 5(3). As shown in Fig 6(3), the route information is attached to the identification signal indicating the route enquiry response.

When the CPU 15 shown in Fig 3 receives the route enquiry response message in the calling switching node (a), first, one of a group of circuits from the calling switching node (a) to relay node (p) is extracted based on the address information "relay PC = p" of the route information contained in the message and then the SW 16 (see Fig 3) is controlled and the extracted circuit is connected to the calling subscriber 8 (see Fig 2). Further, in the example shown in Fig 2, only two switching nodes (b) and (c) for relay were considered. In Fig 5 and Fig 6, explanation will be conducted with respect to a case in which more than two relay switching nodes (p), (q), (r)... are present between the calling switching node (a) and called switching node (d).

Then, the CPU 15 of calling switching node (a) (see Fig 3) employs as a new information the information obtained by deleting the information "relay PC = p" used by itself, among the route information, attaches this route information to the address signal and destination number "045-201-9222", and sends it to the relay switching node (p), as shown in Fig 6(4). More specifically, as shown in Fig 5(4), this signal is sent from CSE 18 shown in

Fig 3 into the relay switching node (p) via the common channel signal network 10.

Furthermore, after the above-described processing, call reception is conducted as shown in Fig 6(6), from the calling switching node (a) to the calling subscriber 8. More specifically, CPU 15 shown in Fig 3 conducts it via SSE 14.

In the relay switching node (p), when the CPU present in this node receives the above-described address signal via CSE (see Fig 3), first, one of a group of circuits from the node (p) itself to a relay switching node (q) is extracted based on the address information "relay PC = q" of the route information contained in the response and then the SW (see Fig 3) is controlled and the extracted circuit is connected to the input circuit.

Then, the information obtained by deleting the information "relay PC = q" that was used by itself, among the route information, is considered as a new route information and this route information is attached to the address signal (contains destination number, same hereinbelow), and sends it to the relay switching node (q), as shown in Fig 6(5). More specifically, as shown in Fig 5(5), this signal is sent from CSE (shown in Fig 3) located in the relay switching node (p) to the relay switching node (q) via the common channel signal network 10.

Then similar processing is successively conducted in various relay switching nodes indicated by route information and the call setting processing is conducted till the called switching node (d). Therefore, the amount of route information attached to the address signal is reduced step by step for each advance to the next relay switching node, and when the called switching node (d) receives the address signal, the route information is absent. Thus, the effective call setting processing can be conducted.

A procedure similar to the ordinary call processing procedure is executed after the arrival of the address signal to the called switching node (d), as described above.

Thus, first, a circuit to the called subscriber 9 is extracted based on the destination number received together with the address signal and calling to the called subscriber 9 is conducted as shown in Fig 5 or Fig 6(6).

Then, and address completion signal ACM is returned, as shown in Fig 6(8) from the called switching node (d) to the calling switching node (a) via all of the relay switching nodes.

Then, if the response comes from the called subscriber 9 to the called switching node (d) as shown in Fig 6(9), the response signal ANM is returned, as shown in Fig 6(10), from the called switching node (d) to the calling switching node (a) via the relay switching nodes. As a result, the response is produced from the calling switching node (a) to the calling subscriber 8, as shown in Fig 6(11).

The above-described call processing procedure makes it possible to establish communication between the calling subscriber 8 and called subscriber 9, and the communication is conducted as shown in Fig 6(12).

Processing conducted when a subscriber terminates the call during communication will be described below with reference to a case in which the calling subscriber 8 produces a disconnection request.

First, if the calling subscriber 8 produces a disconnection request, in the calling switching node (a), the CPU 15 shown in Fig 3 receives the signal via SSE 14, attaches identification number "calling PC = a" of the calling switching node (a), the requested speed information "6 Mb/s", and the route information received as a route enquiry response message during calling to the identification signal indicating the disconnection notification and sends it as a disconnection notification message to the route selection node 12, as shown in Fig 6(14). More specifically, this signal is sent by CPU 15 shown in Fig 3 from CSE 18 via the common channel signal network 10.

In the circuit selection node 12, this signal is received by CPU 20 via the CSE 22 shown in Fig 4, and then the below-described release processing is conducted. Then, the release completion message shown in Fig 6(15) is returned from CSE 22 shown in Fig 4 to the calling switching node (a) via the common channel signal network 10 , as shown in Fig 5(15).

As a result, the release completion shown in Fig 6(16) is conducted from the calling switching node (a) to calling subscriber 8 and then the disconnection signal shown in Fig 6(17) is successively transferred from the calling switching node (a) to called switching node (d) via all of the relay switching nodes. As a result, disconnection is conducted as shown in Fig 6(18) from the calling switching node (d) to the called subscriber 9.

Furthermore, if the release completion shown in Fig 6(19) is conducted from the called

subscriber 9 to called switching node (d), then the release completion signal shown in Fig 6(20) is successively transferred from the called switching node (d) to the calling switching node (a) via the relay switching nodes and the disconnection processing is completed.

The route selection processing conducted when the route enquiry message is received by the route selection node 12 from the calling switching node (a) via the common channel signal network 10 shown in Fig 2 will be described below based on the operation flow chart shown in Fig 7 and a structural diagram of various data shown in Figs 8-10. The operation flow chart shown in Fig 7 is executed by activating the route selection processing program (not shown in the figures) by the CPU 20 shown in Fig 4. The explanation below is conducted with respect to the information transmission network 7 consisting of switching nodes (a), (b), (c), and (d) shown in Fig 2.

First, the route selection node 12 receives a requested speed information "6 Mb/s", destination number "045-201-9222", and identification signal "calling PC = a" of the calling switching node (a) together with the identification signal indicating the route enquiry as the route enquiry message from the calling switching node (a) (S1 in Fig 7).

As a result, the CPU 20 shown in Fig 4 determines, as described below, the called switching node number "called PC" connected to the called subscriber 9 shown in Fig 2 from the destination number DN (S2 in Fig 7).

First, the destination number DN = 045-201-9222 is set into an input register 25 shown in Fig 8 in the CPU 20 shown in Fig 4. On the other hand, six tables from the first order to the sixth order for destination number (DN) / called switching node (PC) conversion are stored in DB 24 shown in Fig 4. Then, among the ranks of the destination number DN set in the input register 25, six upper ranks, excluding the initial "0" are indexed from the first-order table to the sixth-order table in the sequence of (1) → (2)→ (3) → (4) → (5) → (6) as an index key information 26. The initial rank "0" is a number for the identification of a long-distance call and is not required in the processing determining the called PC. Furthermore, the last three ranks "222" represent the circuit number of the called subscriber in the called switching node and therefore also require no processing.

As an example of specific processing, first, an address on the first-order table 27_1

corresponding to a called number "4" in the position (1) on the input register 25 is indexed. Here, the address of the second-order table 27_2 corresponding to the called number "4" is contained and the corresponding second-order table 27_2 is thereby referenced.

In the second-order table 27_2, the address on the second-order table 27_2 corresponding to the called number "5" in the position (2) on the input register 25 is indexed. Here, the address of the third-order table 27_3 corresponding to the called number "5" is contained and the corresponding third-order table 27_3 is thereby referenced.

Similarly, the third-order table 27_3 to fifth-order table 27_5 are referenced by the called numbers "2", "0". And "1" corresponding to positions (3) to (5).

Here, a called switching node number is stored in the addresses of the last sixth-order table. Therefore, in the sixth-order table 27_6 shown in Fig 8, the address on the sixth-order table 27_6 corresponding to the called number "9" on the input register 26 is indexed and the called switching node number "called PC" is thereby finally determined. In the example shown in Fig 2, the called PC = d is determined.

Then, the CPU 20 shown in Fig 4 determines, in the manner described below (S3 in Fig 7), a route information which is a candidate for a route from the calling switching node to the called switching node, from the calling switching node number "calling PC" received as a route enquiry message from the calling switching node (a) and the called switching node number "called PC" determined by the processing in S2 illustrated by Fig 7.

The first to third order tables shown in Fig 9 are stored as the route information data in DB 24 shown in Fig 4.

First, an address on the first order table 28_1 corresponding to the calling switching node number "calling PC" is indexed. Here, the address of the second order table 28_2 corresponding to calling switching node number "calling PC" is contained and the corresponding second order table 28_2 is thereby referenced.

In the second order table 28_2, an address on the second-order table 28_2 corresponding to the called switching node number "called PC" is indexed. Here, the address of the third order table 28_3 corresponding to the combination of the calling switching node number "calling PC" and called switching node number "called PC" is contained and the corresponding third order table 28_3 is thereby referenced.

Here, in the final third order table, the candidate of the route corresponding to the combination of the calling switching node number "calling PC" and called switching node number "called PC" is stored as the route information. As a result, in the example shown in Fig 2, (1) a-d, (2) a-b-d, and (3) a-c-d are determined, as shown in Fig 7(A), as candidates of the routes corresponding to the calling switching node number "calling PC = a" and called switching node number "called PC = d".

Then, the CPU 20 shown in Fig 4 determines, as described below, the present usage amount of the circuit in links between nodes of route candidates (1), (2), and (3) determined by the above-described processing in S3 shown in Fig 7 and adds (S4 in Fig 7) the requested speed information received as the route enquiry message from the calling switching node (a).

In DB 24 shown in Fig 4, the two tables (first order table and second order table) shown in Fig 10(b) are stored as the present usage amount data for links between the nodes as a part of control data of links between the nodes.

First, an address on the first-order table 30_1 corresponding to the output switching node number "output PC" of the link that is presently under consideration is indexed. Here, the address of the second-order table 30_2 corresponding to the output switching node number "output PC" is contained and the corresponding second order table 30_2 is thereby referenced.

In the second order table, the usage capacity (the sum of circuit speed during present usage) of the circuit corresponding to the link determined by the combination of the output switching node number "output PC and input switching node number "input PC" is stored. Therefore, the usage capacity of the circuit corresponding to the link under consideration is determined by indexing the address on the second-order table 30_2 corresponding to the input switching node number "input PC" of the link which is presently under consideration.

More specifically, among the route candidates determined by processing in S3 shown in Fig 7, the present usage amount is determined by the above-described processing by using the tables shown in Fig 10(b) with respect to the link a-d of route candidate (1) a-d, links a-b and b-d of route candidate (2) a-b-d, and links a-c and c-d for route candidate (3) a-c-d. As a result, as shown in Fig 7B, the following date were obtained: link a-d : 45 Mb/s, link a-b : 20 Mb/s, links b-d, a-c, and c-d : 60 Mb/s.

The requested speed 6 Mb/s received as the route enquiry message from the calling

switching node (a) is added to the present usage amount for each link determined in the above-described manner. Thus, the addition produced the following results for links a-d, a-b, b-d, a-c, and c-d : 51 Mb/s, 26 Mb/s, 66 Mb/s, 66 Mb/s, and 66 Mb/s, respectively, as shown in Fig 7B.

Then, CPU 20 shown in Fig 4 determines, in the following manner, the maximum capacity of circuits for links between the nodes representing the route candidates (1), (2), (3) determined by the processing in S3 shown in Fig 7 and can calculates the usage ratio (%) for each link (Fig 5, S5) as the percentage obtained by dividing the results of addition determined in S4 in Fig 4 by the maximum capacity (S5 in Fig 7).

In DB 24 shown in Fig 4, the two tables (first-order table and second-order table) shown in Fig 10(a) are stored as the maximum capacity for links between the nodes as a part of control data of links between the nodes.

First, an address on the first-order table 29_1 corresponding to the output switching node number "output PC" of the link that is presently under consideration is indexed. Here, the address of the second-order table 29_2 corresponding to the output switching node number "output PC" is contained and the corresponding second-order table 29_2 is thereby referenced.

In the second-order table, the maximum capacity (the maximum value of the speed that can be used) of the circuit corresponding to the link determined by the combination of the output switching node number "output PC and input switching node number "input PC" is stored. Therefore, the maximum capacity of the circuit corresponding to the link under consideration is determined by indexing the address on the second-order table 29_2 corresponding to the input switching node number "input PC" of the link which is presently under consideration.

More specifically, the maximum capacity is determined by the above-described processing by using the tables shown in Fig 10(a) with respect to links a-d, a-b, b-d, and a-c similarly to S4 in Fig 7. The results, as shown in Fig 7(C) are as follows: link a-d 50 Mb/s, links a-b, b-d 100 Mb/s, links a-c, c-d 200 Mb/s.

The usage ratio (%) of each link is determined as a percentage obtained by dividing the results of addition for each link determined by processing in S4 shown in Fig 7 by the maximum capacity of each link determined in the above-described manner. As a result, the

usage ratio a-d, a-b, b-d, a-c, and c-d of each link is 102%, 26%, 66%, 33%, and 33%, respectively, as shown in Fig 7C.

After the above-described processing, CPU 20 shown in Fig 4 considers the maximum usage ratio of the links in the routes among route candidates (1) a-d, (2) a-b-d, and (3) a-c-d determined by the treatment in S5 of Fig 7 as the usage ratio of the route and selects the route candidate with the smallest usage ratio as the optimum route (S6 in Fig 7).

More specifically, in the route candidate (1) a-d, the usage ratio of 102% of link a-d is the usage ratio of the route candidate (1) a-d, as shown in D(1) in Fig 7. In the route candidate (2) a-b-d, the usage ratio of link b-d is the highest among the links a-b and b-d. Therefore, the usage ratio of 66% thereof is the usage ratio of the route candidate (2) a-b-d, as shown in D(2) in Fig 7. Furthermore, in the route candidate (3) a-c-d, the usage ratios of links a-c and c-d are the same. Therefore, the usage ratio of 33% thereof is the usage ratio of the route candidate (3) a-c-d as shown in F(3) in Fig 7. Therefore, among the route candidates (1) – (3), the route candidate (3) a-c-d with the minimum usage ratio is selected as the optimum route, as shown in F(3) in Fig 7.

In addition to the above-described processing, the requested speed 6 Mb/s is added, as shown in Fig 7(E) to the links a-c and c-d in the selected route (3) and the second-order table 30_2 in Fig 10(b) is renewed (S7 in Fig 7).

Upon completion of the above-described processing, CPU 20 shown in Fig 4 returns the route enquiry response message having attached thereto the route information relating to the selected optimum route a-c-d from CSE 22 to the calling switching node (a) via the common channel line network 10, as shown in Fig 5(3) that has already been described.

The route selection processing for selection of the optimum route in the route selection node 12 shown in Fig 12 is executed as described above.

Finally, the release treatment in the route selection node 12 relating to a case when the release notification message was sent from the calling switching node (a) to the route selection node 12 as a result of disconnection request conducted as shown in Fig 5 or Fig 6(13) by the calling subscriber 8 shown in Fig 2 will be explained.

As has already been described, the release notification message was obtained by attaching the identification number "calling PC = a" of the calling switching node (a),

requested speed information "6 Mb/s", and route information received as the route enquiry message during calling to an identification signal indicating the release notification (see (14) in Fig 6). The CPU 20 (Fig 4) of route selection node 12 executes an operation flow chart of release processing shown in Fig 11 with respect to the release notification message.

First, a release notification message is received from the calling switching node (S9 in Fig 7). Now, let us assume according to the example illustrated by Figs 7 to 10 that the route information of the optimum route is the route a-c-d shown in Fig 2 and the requested speed is 6 Mb/s. Furthermore, the calling switching node is (a).

Then the second order table 30_2 shown in Fig 10(b) in DB 24 shown in Fig 4 is referenced with respect to links a-c and c-d present in the route information and the requested speed of 6 Mb/s is deducted from the present usage amount and renewed (S10 in Fig 7).

After this processing, as has already been shown in Fig 5(15) and Fig 6(15), the release completion message is returned from CSE shown in Fig 4 to the calling switching node (a) via the common channel signal network 10.

The release processing in the route selection node 12 is executed in the above-described manner.

As described above, in the present embodiment, the route selection node 12 shown in Fig 2 conducts unified management of the route information of information transmission network. As a result, the traffic control of the entire network can be conducted so as to minimize the blocking ratio during communication.

Furthermore, in the call setting processing conducted when the optimum route is selected, the route information is successively transferred from the calling switching node (a) to the called switching node (d) and in this ca\se the route information attached to the address signal is reduced unit by unit in the course of advancement to the next switching node, and when the called switching node (d) receives the address signal, it contains no route information. Therefore, effective call setting processing can be conducted.

Moreover, in the route selection processing shown in Fig 7 which is conducted in the route selection node, when the route with a minimum usage ratio (S6) is selected as an optimum route, if there are several routes with a minimum usage ratio, rational route selection

can be conducted by setting the optimum route based on the preset priority.

(Effect of the Invention)

In accordance with the present invention, the route selection node conducts a unified management of information relating to the route selection between the switching nodes and selects an optimum route between a calling switching node and a called switching node such that the blocking ratio during communication is minimized, and call setting between the calling subscriber and called subscriber is conducted in the communications network based on the optimum route. As a result, the uniformity of traffic in the network can be improved.

Furthermore, in the call setting procedure, first, the route selection node returns the route information to the calling switching node, and then, while the route information and call setting signal are successively transferred from the calling switching node to the called switching node, in each of the switching nodes the next switching node to which the connection should be made is selected based on the received route information, a circuit to the selected node is selected, and the call setting signal containing the route information if sent to the next node. Therefore, circuits corresponding to the optimum route to the called switching node are successively set, the overhead (delay) during call setting is minimized, and call setting between the calling subscriber and called information can be conducted.

4. Brief Description of the Drawings

Fig 1 is a block diagram illustrating the present invention.
Fig 2 illustrates a network structure of the present embodiment.
Fig 3 illustrates a structure of a switching node.
Fig 4 illustrates a structure of a route selection node (DB node).
Fig 5 illustrates the operation of call setting processing.
Fig 6 is an operation timing chart of call setting processing.
Fig 7 is an operation flowchart of route selection processing.
Fig 8 illustrates a configuration of destination number (DN) / called switching node

number (PC) conversion data.

Fig 9 illustrates a configuration of a route information data.

Fig 10(a), (b) illustrates a configuration of inter-node link management data.

Fig 11 is an operation flow chart of release processing.

1 – communications network.

$2_1 \sim 2_n$ – switching node.

3 – calling subscriber.

4 – called subscriber.

5 – route selection node.

6 – route enquiry message.

Fig 1. Block diagram illustrating the present invention:

1 – communications network;

2_1 – calling switching node;

2_2 – switching node;

2_3 – switching node;

2_n – called switching node;

3 – calling subscriber;

4 – called subscriber;

5 – route selection node;

6 – route enquiry message.

Fig 2. Network structure of the present embodiment:

7 – information transfer network;

8 – calling subscriber (calling user);

9 – called subscriber (called user);

10 – common channel signal network (for control information transfer);

11_1 – common channel relate node;

11_m – common channel relay node;

12 – route selection node (DB node);

Switch node (a), switch node (b), switch node (c), switch node (d)

____ : communications information (between a calling subscriber and a called subscriber)

------ : control signal information (between switching node and DB node) (between switching node and switching node)

Fig 3. Structure of switching node:

Switching node (a)

Circuit between nodes (a-b)

Circuit between nodes (a-b)

To common channel signal network 10

SSE – subscriber line signal device;

SW – speech switch;

CPU : central procreating unit;

MEM : memory device;

CSE : common channel signal device

Fig 4. Structure of a route selection node (DB node):

To common channel signal network 10

CPU : central processing unit;

MEM : memory device;

CSE : common channel signal device

DB : data base storage

Fig 5. Operation of call setting processing:

7 – information transmission network

8 – calling subscriber

9 – called subscriber

10 – common channel signal network

12 – route selection node

Calling switching node (a) (PC = a)

Relay switching node (PC = p)

Relay switching node (PC = q)

Called switching node (d) (PC = d)

Fig 6. Operation timing chart of call setting processing.

Calling switching node (a) (PC = a)

12 – route selection node (DB node)

(1) Calling (045-201-9222, requested speed = 6 Mb/s)

Requested speed = 6 Mb/s

Called number = 0452019222

Calling PC = a

Route enquiry

Route enquiry response

Route information

Relay PC = p

Relay PC =q

Re lay PC = r

Called PC = d

Relay switching node (PC = p)

Relay switching node (PC = q)

Called switching node (PC = d)

(6) Call attachment

Route information

Called PC = d

Relay PC = r

Relay PC = q

Called number

Address signal

Route information

Called PC = d

Relay PC = r

Address signal

Address signal

(8) Address completion signal ACM

(10) Response signal

(11) Response

(12) During communication

(13) Disconnection request

Requested speed 6 Mb/s

Route information

Called PC = d

Calling PC = a

Release notification

(16) Release completion

(15) Release completion

(17) Disconnection signal

(18) Disconnection

(20) Release completion signal

(19) Release completion

Fig 7. Operation flowchart of route selection processing:

Route Section processing

S1 : "Route enquiry message" is received from a calling switching node (calling PC = a; DN = 045-201-9222, requested speed 6 Mb/s)

S2 : Called switching node number _called PC) is determined from the called number (DN)

S3 : Route information is determined from calling PC (received from calling switching node) and called PC

S4 : present usage amount of links between nodes of route information (1, 2, 3) is determined and requested speed = 6 Mb/s is added

S5 : maximum capacity of links between nodes is determined and usage ratio is calculated form the maximum capacity and the results of the above-mentioned addition

S6 : maximum value of the link usage ratio in the route is considered as the usage ratio of this route and the route with a minimum usage ratio is selected as the optimum route

S7 : requested speed = 6 Mb/s is added to the links in the selected route (3)

S8 : "Route enquiry response message" having the route information (a-c-d) attached thereto is returned to the calling switching node

END

Called PC

DN – PC conversion

Calling PC, called PC

Route information

Route information

Output – Input

Present usage amount

Present usage amount of a link

Present usage amount

Requested speed

Output – Input

Present usage amount

Present usage amount of a link

Addition results

Maximum capacity

Optimum route

Present usage amount of a link

Fig 8. Configuration of destination number (DN) / called switching node number (PC) conversion data:

Citing sequence

25 Input register

26 Citing key information

Second order table address

Second order table 27_2

Third order table address

Sixth order table 27_6

Called switching node number

Fig 9. Configuration of route information data:

Calling PC

Called PC

First order table 28_1

Second order table address

Second order table 28_2

Third order table address

Third order table 28_3

Route number

Route information

Fig 10. Configuration of inter-node link management data:

(a)Maximum capacity data for links between nodes

Output PC

First order table 29_1

Second order table address

Input PC

Second order table 29_2

Maximum capacity of link (maximum value of speed that can be used)

(b) Present usage amount data for links between nodes

Output PC

First order table 30_1

Second order table address

Input PC

Second order table 30_2

Usage capacity of link (sum of circuit speed presently in use)

Fig 11. Operation flow chart of release processing:

Release processing

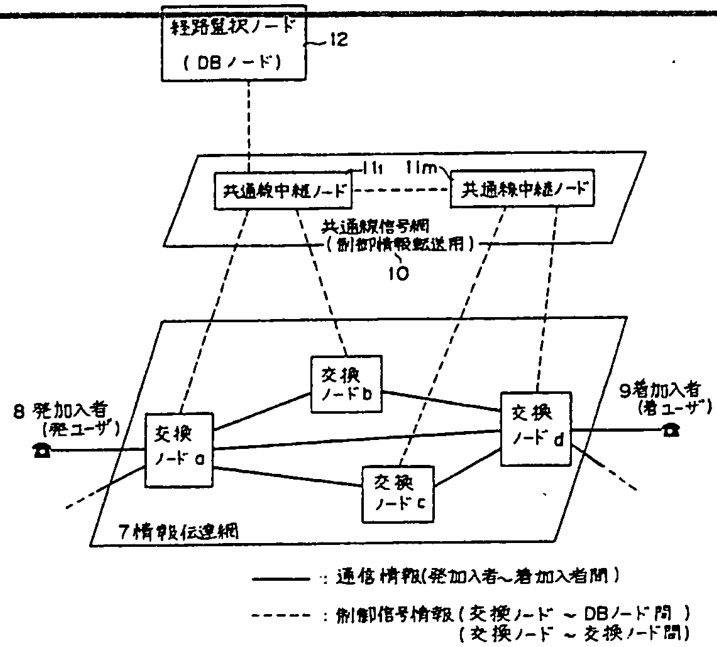
S9 : "Release notification message" is received from the calling switching node (route information (=a-c-d); requested speed (=6 Mb/s))

S10 : requested speed = 6 Mb/s is deducted from each link (a-c, c-d) in the route information

S11 : "Release completion message" is returned to calling switching node

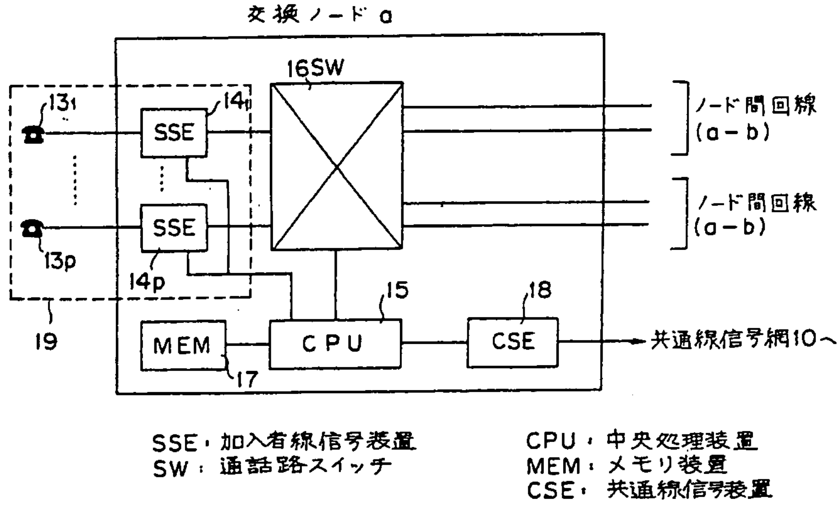
END

Present usage amount of the link.



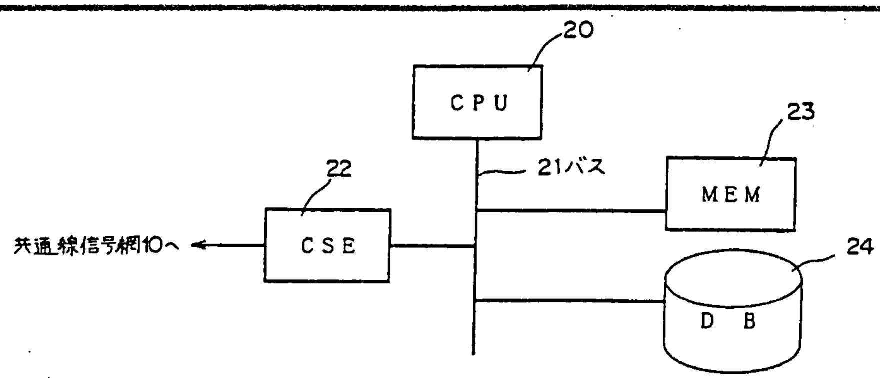
本実施例の網構成図

第 2 図



交換ノードの構成図

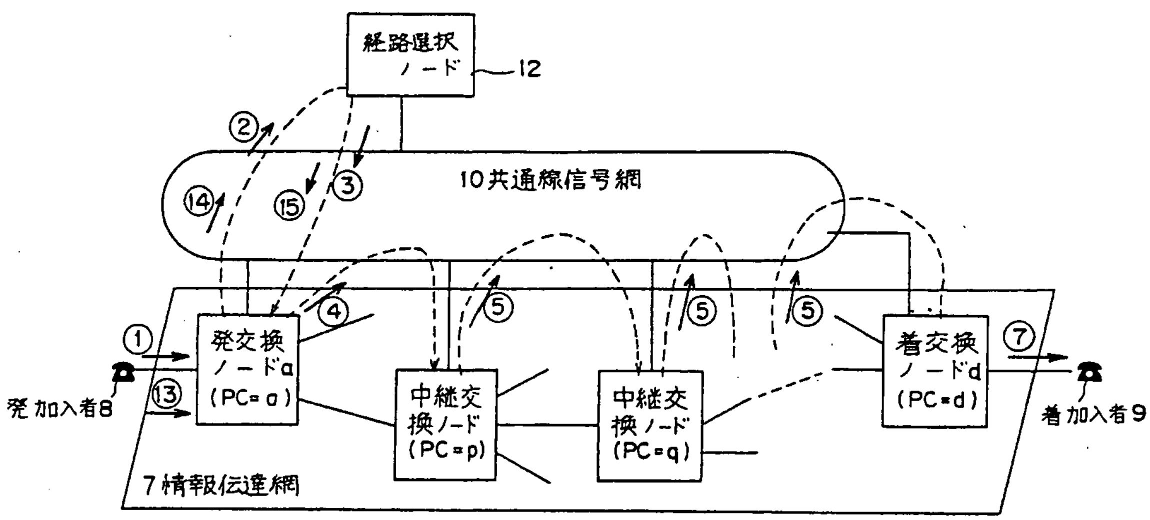
第 3 図



CPU：中央処理装置
MEM：メモリ装置
CSE：共通線信号装置
DB　：データベース記憶装置

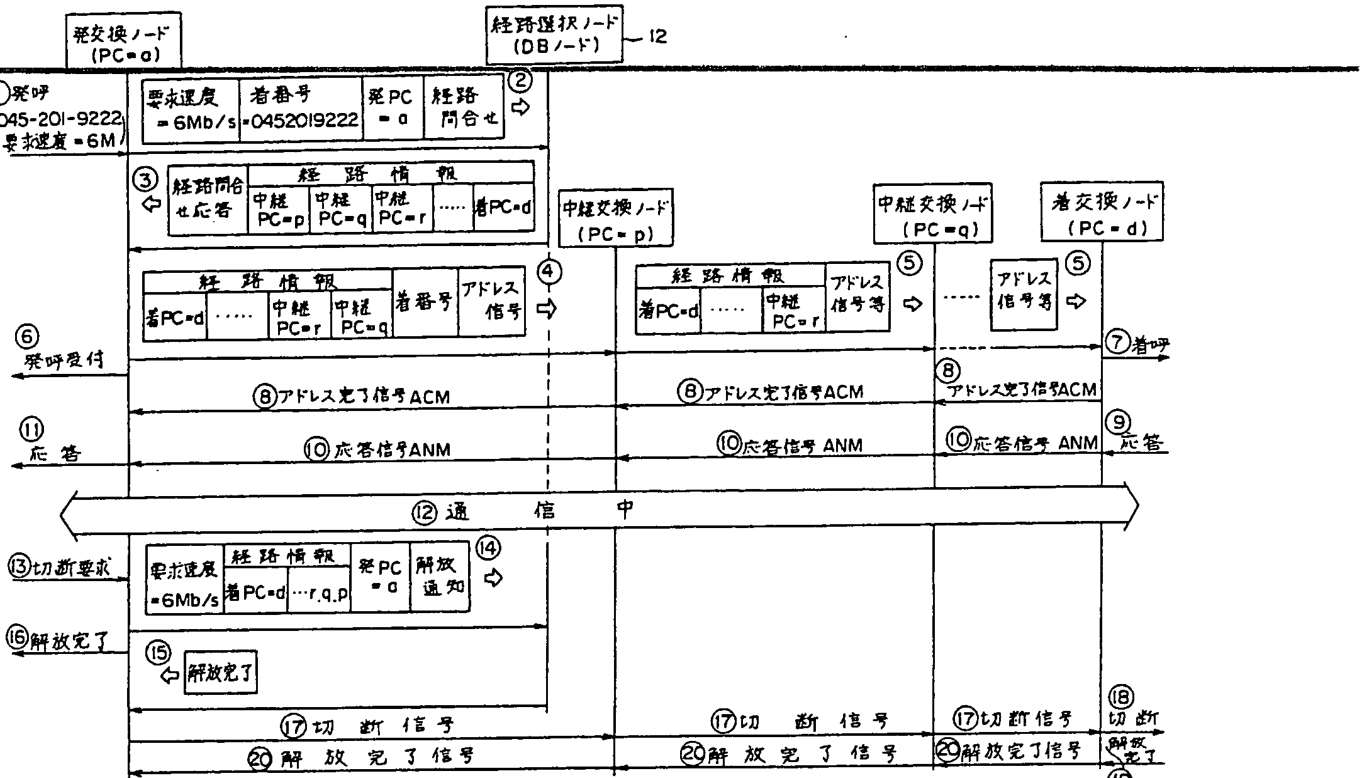
経路選択ノード（DBノード）の構成図

第4図

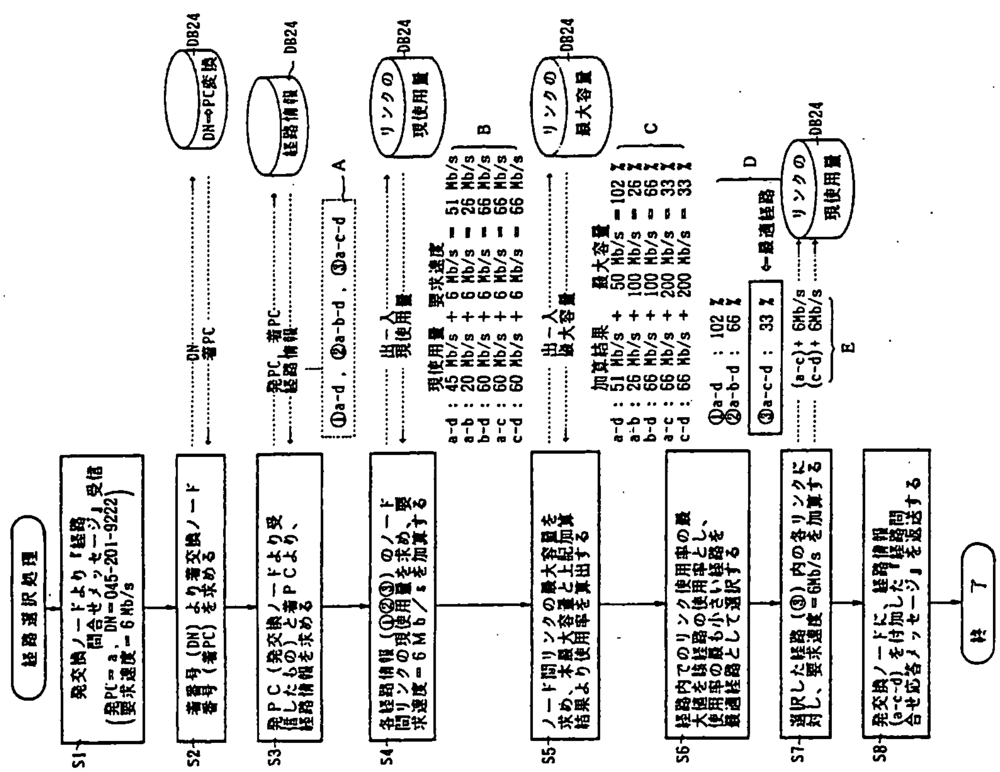


呼設定処理の動作説明図

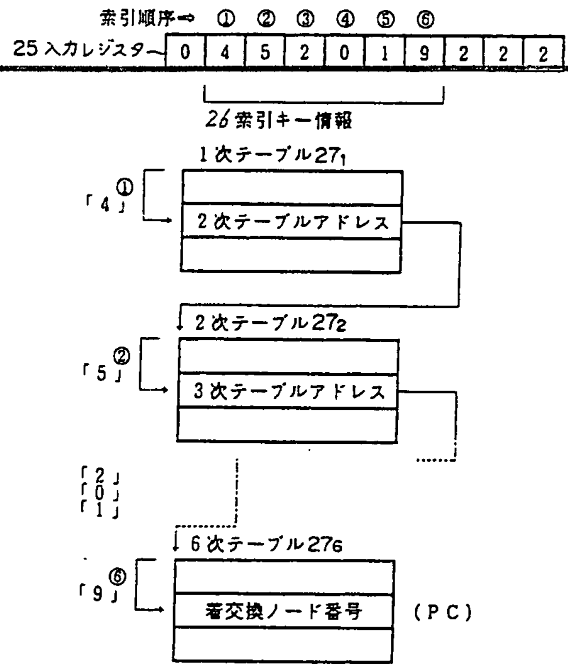
第5図



呼設定処理の動作タイミングチャート
第 6 図

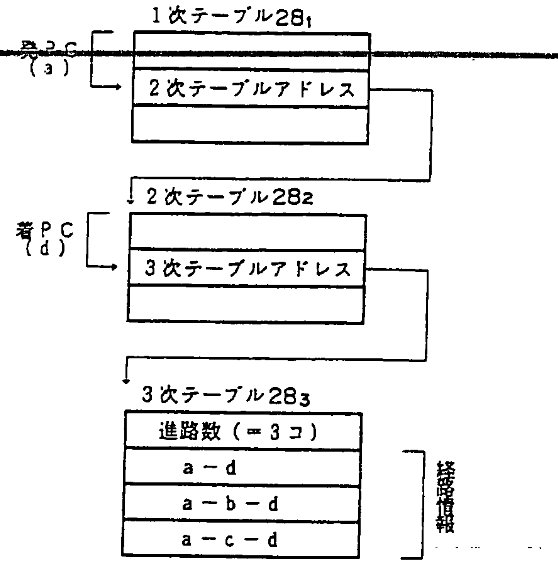


経路選択処理の動作フローチャート
第 7 図



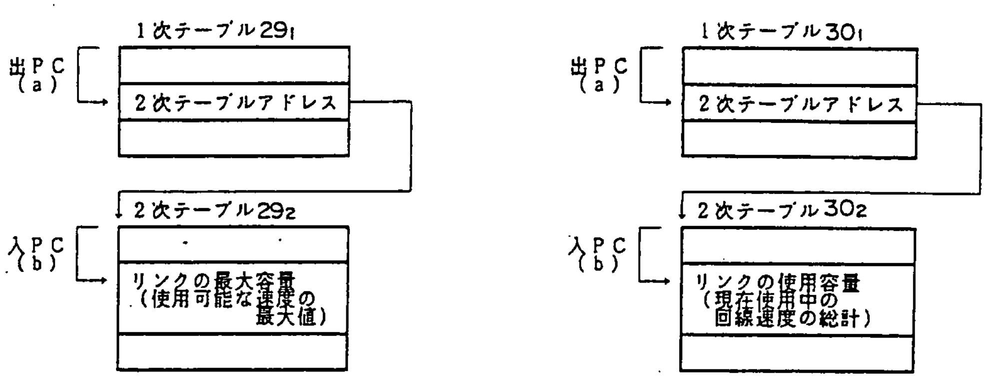
着番号(DN)/着交換ノード番号(PC)
変換データの構成図

第 8 図



経路(ルート)情報データの構成図

第 9 図

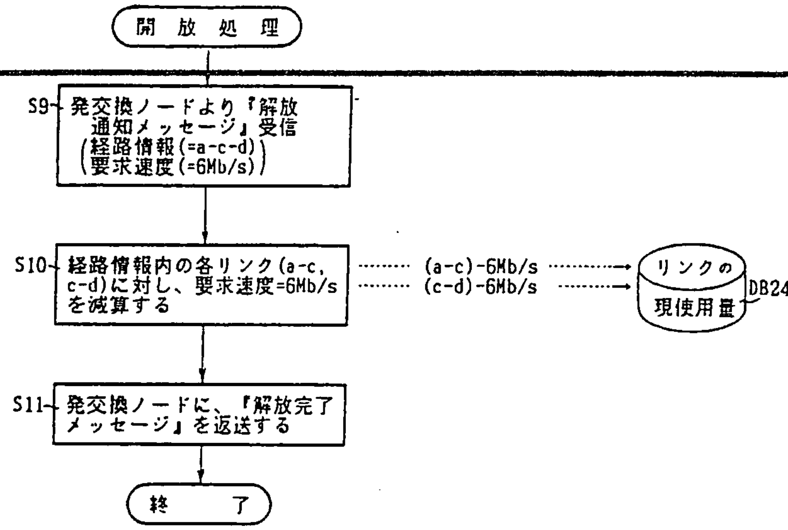


ノード間リンクの最大容量データ
(a)

ノード間リンクの現使用量データ
(b)

ノード間リンク管理データの構成図

第 10 図



解放処理の動作フローチャート

第 11 図

第4図は、経路選択ノード（ＤＢノード）の構成図、

第5図は、呼設定処理の動作説明図、

第6図は、呼設定処理の動作タイミングチャート、

第7図は、経路選択処理の動作フローチャート、

第8図は、着番号(DN)／着交換ノード番号(PC)変換データの構成図、

第9図は、経路（ルート）情報データの構成図、

第10図(a)、(b)は、ノード間リンク管理データの構成図、

第11図は、解放処理の動作フローチャートである。

1・・・通信網、

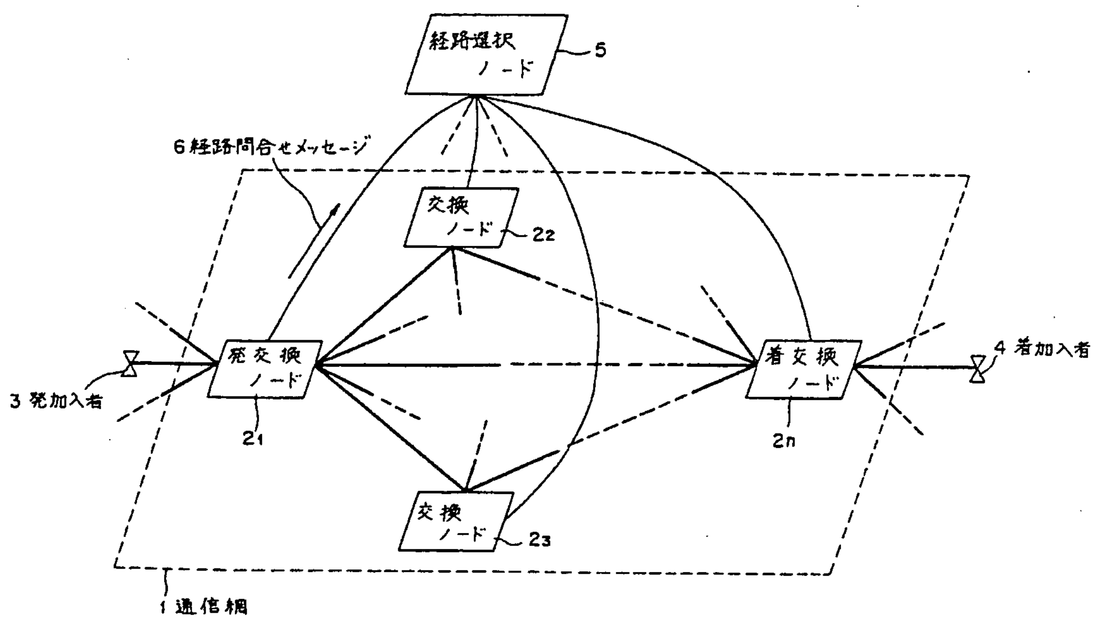
2_1～2_n・・・交換ノード、

3・・・発加入者、

4・・・着加入者、

5・・・経路選択ノード、

6・・・経路問合せメッセージ.

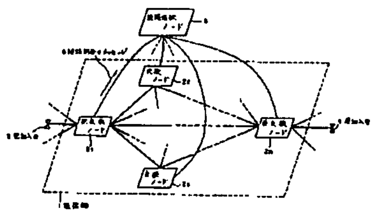


本発明のブロック図

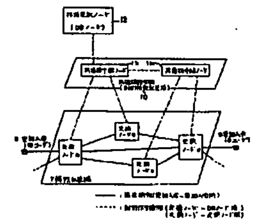
第1図

第4図は、経路選択ノード(DBノード)の構成図、
第5図は、呼設定処理の動作説明図、
第6図は、呼設定処理の動作タイミングチャート、
第7図は、自動経路選択処理の動作フローチャート、
第8図は、着番号(DN)/着交換ノード番号(PC)変換データの構成図、
第9図は、経路(ルート)情報データの構成図、
第10図(a)、(b)は、ノード間リンク管理データの構成図、
第11図は、障害処理の動作フローチャートである。

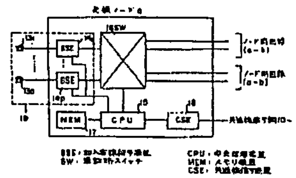
1・・・通信網、
2_1～2_n・・・交換ノード、
3・・・発加入者、
4・・・着加入者、
5・・・経路選択ノード、
6・・・共通線信号メッセージ。



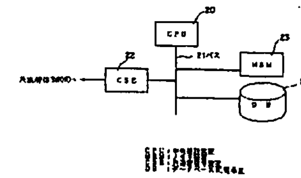
本発明のブロック図
第1図



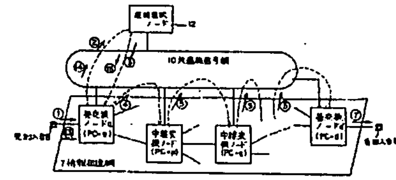
第2図



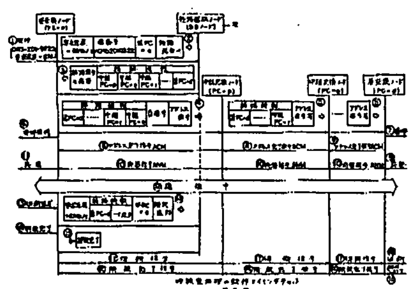
交換ノードの構成図
第3図



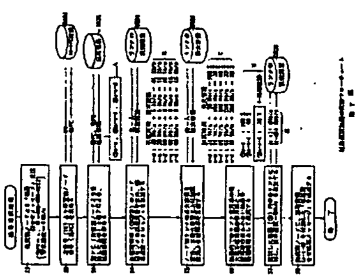
経路選択ノード(DBノード)の構成図
第4図



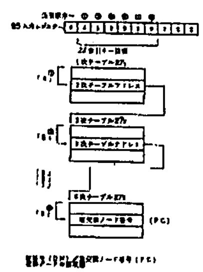
呼設定処理の動作説明図
第5図



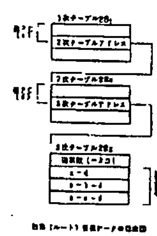
呼設定処理の動作タイミングチャート
第6図



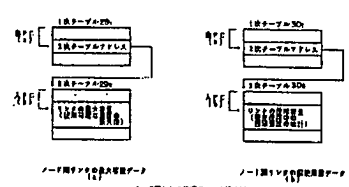
第7図



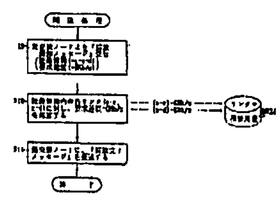
第8図



第9図



第10図



第11図